Claims

1. ~~Method for the control of mechanisms or technical systems~~
characterized in that

a) the mechanisms or technical systems to be controlled are stored in the control by way of their elementary functions (8) with the states thereof defined according to the instructions and the appropriate signal vectors (15) of the sensors (13) and actuators (12), whereby starting from a defined reference state (18) at the beginning of the control activation a continuous comparison is made of the actual states transmitted of the technical equipment by the sensors (13) with the desired states (24) stored in the control for all elementary functions and hence any deviation in the system to be controlled from the desired state (24) according to the instructions is detected,

b) a new elementary instruction (16) that changes the state of the mechanisms or the technical system with its start updates the desired state (24) for the comparison and monitors the time period until the acknowledgment of the new state according to the instruction, based on also stored permissible control time periods (17),

c) whereby sensor signals and comparable information serve exclusively to identify states of elementary functions (8), state changes exclusively occur through the start of elementary instructions (16), to which the sensor and actuator signals are assigned as desired state and the application instructions (32) freely defined on logical-functional language level are defined by the appropriate assignment of elementary instructions (16).

2. Method to Claim 1
characterized in that

a) in the control in a special programme module here referred to as EF-controler (23), the states of all elementary functions (8) are managed as ordered actual desired states (24) and as current actual states (25) with the appropriate actuators (12) and sensors (13),

b) whereby any change in the state of the technical system detected through the sensors (13) is therefore assigned to the concerned elementary function (8) as current actual state and can be compared with the desired state (24) managed in the control and evaluated.

3. Method to Claims 1 or 2
characterized in that

a) for a detected actual state (25) of an elementary function (8) that is not equivalent to the desired state (24), the signal vector (15) that describes the actual state is handed over to another special programme module of the control, here referred to as not-desired state evaluator (38),

b) whereby in this not-desired state evaluator (38) reaction instructions (72) are stored for selected states of elementary functions (8) that are started on equivalence with the state that was handed over for check,

c) and in all cases, special error messages are produced that indicate the name of the elementary function concerned and the deviating signal.

4. Method to Claims 1 to 3
characterized in that

a) to an application instruction (32), as an instruction set the new desired states (24) of the sensors (13) and actuators (12), die control times (17) for the new desired state (24) as well as the reaction instructions (72) to be started in case of deviations are assigned classified, in each case, as reaction instructions (72) for selected state messages, to be deleted and set prior to the start and after the execution, respectively,

b) whereby another special programme module of the control, here referred to as instruction starter (35), takes on the required organization in the system, and thus also the release of a next instruction in case of instruction sequences after the execution message of the previous instruction as well as the organization of parallel instructions (45) by temporary opening, as necessary, of parallel execution sequences are realized.

5. Method to Claims 1 to 4
characterized in that

a) in another programme module here referred to as state monitor (37), sensor signals (13)

and other information to be controlled are integrated into a continuous data word, whereby the address of the appropriate elementary function (8) in the EF-controler (36) of the control maintains assigned to the signals,

b) for the comparison, each desired signal (30) is faced by the actual signal (31) of the sensor message in equal structure,

c) whereby for a detected deviation of an actual signal, the programme module state monitor (37) updates this actual signal in the EF-controler (36) as the new actual state of the elementary function (29),

d) and after the updating and transmission for evaluation in the EF-controler (36) the changed signal is entered as the new comparison state in the state monitor (37) so that a comparison in the state monitor (37) is always made to the state evaluated last and hence each change in state is evaluated only once,

e) whereby the comparison of the desired and actual signals (30, 31) in the state monitor (37) is made directionally and after an interruption for the evaluation of a deviation the comparison is continued at the signal succeeding the interruption place, which ensures that each state change that is sufficiently long in time can be detected and evaluated.

6. Method to Claims 1 to 5
characterized in that

a) each recorded state change is entered by the programme module state monitor (37) in an event-time protocol (85) and can be stored there,

b) whereby in the simplest way time-dependent process parameters become accessible so that also signal vibrations can be detected and, if necessary, filtered out.

7. Method to Claims 1 to 6
characterized in that

a) the subdomain execution computer (2) with the programme modules instruction starter (35), EF-controler (36), not-desired state evaluator (38) and state monitor (37) after transmission of an elementary instruction (16) to the programme module instruction

starter (35) in the control includes no check for permissibility,

b) the execution of a received instruction is, in each case, autonomously realized by the programme modules assigned to the execution computer (2),

c) in the subdomain instruction computer (3) of the control blocking lists (88) for the mutually exclusive states are managed on the logical-functional instruction level, which take on that proportion of functional blockings that is determined by the process and machine sides,

d) whereby an application instruction (32), in addition to elementary functions (8) to be changed also contains the information, for which other instructions blockings are to be set or deleted in the blocking list (88) during or after the execution of this application instruction (32).

8. Method to Claims 1 to 7
characterized in that the execution computer (2) and the instruction computer (3) work decoupled in time by one programme step,

a) the executing part of the control, the execution computer (2), executes a received instruction autonomously, whereby an instruction-managing part of the control, the instruction computer (3), makes the checked next instruction available to the executing part execution computer (2) in an intermediate storage as instruction buffer (34),

b) and after provision of an instruction in the instruction buffer (34) of the execution computer (2) the state in the instruction computer (3) is updated to the condition that will be after the execution of this instruction, and the check to this expected state of the then subsequent instruction for permissibility in the instruction computer (3) is made already during the execution of the preceeding instruction,

c) if due to an error the expected state does not appear, the checked instruction from the instruction buffer (34) is reset and the system updated to error state.

9. Method to Claims 1 to 8
characterized in that application instructions (32) are prepared

a) by assigning to the application instructions (32) to be functionally defined close to the process by language, from the previously defined elementary instructions (16), such elementary instructions single, parallel or as a sequence,

b) by defining the blocking conditions on instruction level for the updatings to be made when activating the application instruction (32), in the blocking list in the instruction computer (88),

c) by determining the reaction instructions (72) for selected deviations and suitable error messages,

d) by filing this information in an instruction library (92), where the control calls the instruction contents for application instructions (32).

10. Method to Claims 1 to 9
characterized in that
an application programme (93) for the operation of the technical system determines the sequence of defined application instructions (32) that are to be executed one after the other or in parallel.

11. Method for the development of control software
characterized in that
the development of the control software is supported by a development system with dialogue ability,

a) whereby for the description of the system to be controlled the data of the hierarchical function structure (5) is requested,

b) each lower end of this structure is considered as elementary function (8) and each elementary function (8) is to be defined with their instruction states also in a dialogue,

c) whereby to these defined elementary instructions (16), the signals of the sensors (13), of the actuators (12), the control times (17) for the transition between the states according to the instructions, and a reference state (18) are to be assigned,

d) the integration of more complex partial systems can also be performed as elementary function (8), if the position in the function structure (5) indicates this,

e) whereby the dialogue system requires only the primary data listed here on the structure (5) and elementary functions (9) as the basis for the description of the functionality of the technical system.

12. Method to Claims 11

characterized in that

the dialogue-guided development system after entry of the primary data establishes and generates

a) the system elementary instruction storage (21),

b) the EF-controler (36) and

c) the desired signal vector (30) and the actual signal vector for the state monitor (37)

and thus the technical system can already be put into operation, checked for error-free signal definition in the reference state (18) and controlled with the defined elementary functions (16) in a state of putting into operation, and be tested and checked as far as permissible with regard to these single instructions.

13. Method to Claims 11 or 12

characterized in that

changes of information on structure (5) and elementary functions (8) are only possible over the editing level (19) and the subsequent automatic generation ensures the consistency of the changed state.

14. Method to Claims 11 to 13

characterized in that the development system for the definition of application instructions (32) in specific dialogues

a) offers the available elementary instructions (16) of the system for assignment,

b) requests blocking conditions for the blocking list (88), whereby the data for blockings to be determined can be given graphically through selection in the function structure (5) and blocking determinations can be given as formulations such as "this elementary instruction", "this elementary function", "this branch of the function structure" or "all functions of this function branch except this elementary instruction",

c) determinations on specific reaction instructions (72) are requested for special errors,

d) all determinations are stored and are classified and managed in the instruction library (92).

15. Method to Claims 11 to 14,

characterized in

a) that for a control system designed in such a manner changes of elementary functions (8) maintain locally limited,

b) that any time, also with calculable local effect, new application instructions (32), blocking conditions in the blocking list (88) or error reactions by reaction instructions (72) can be entered, extended or changed,

c) that differentiated by the assignment of status information (90), new definitions of application instructions (32) and instruction conditions can be made for the system without any reaction on already defined programmes.

16. Equipment for the control of mechanisms or technical systems characterized in

a) that for the different problems different domains of the device are provided and these domains are configurated dependent on the most important features of the problems, whereby, particularly, short times of reaction to detected events and reliable programme runs are achieved,

b) that the programme modules for all time-critical problems of the control, instruction starter (35), EF-controler (36), not-desired state evaluator (38) and state monitor (37) are arranged in a part of the device here referred to as execution computer (2),

c) the execution computer (2), in case of voluminous programmes with great programme variability, has an own processor for these time-critical problems,

d) that the execution computer (2) is autonomous for the communication with the devices to be controlled over the sensors (13), the activiation of actuators (12), the desired/actual state comparison, reactions to deviations of the actual (25) against the desired state (24) and the execution of a received instruction,

e) for the management of application instructions (32) in instruction libraries (92), the management of blocking lists (88), the execution of application programmes (93) by step-by step transmission of instructions to the execution computer (2) and the external communication from the domain of the device here referred to as instruction computer (3), another processor is provided, if the features of c) are valid,

f) for the problems of process design, unless they concern the execution or instruction computer, a domain application computer (4) is provided.

17. Equipment to Claim 16 characterized in that

a) for small-scale controls (94) with a small instruction volume and uncritical time requirements the modules of the execution computer (2) and instruction computer (3) are included in a control hardware module (95) with fixed instruction sets,

b) for the operation and communication usual switching and indication devices (96) are

provided,

c) over an interface (97) an external computer (98) for entering the control software and, if necessary, for a comfortable communication and diagnosis can be coupled.

17 sheets of drawings enclosed.